SynObs
UN Ocean Decade Project

OPST-12, UQAM, Canada
Aug. 15-17th, 2026

OS-Eval TT Updates

Agenda

1. SynObs Updates (By Yosuke Fujii)
2. Other OS-Eval TT activities (By Elisabeth Remy)
3. Discussion toward future OceanPredict plan (By Elisabeth Remy)

Synergistic Observing Network for Ocean Prediction

Led by OceanPedict OS-Eval TT

- Objective

  SynObs will seek the way to extract maximum benefits from the combination among various observation platforms, typically between satellite and in situ observation data, in ocean predictions.

- Strategy

  SynObs aims to identify the optimal combination of different ocean observation platforms through observing system design/evaluation, and to develop assimilation methods with which we can draw synergistic effects.

- Co-chairs Y. Fujii (JMA/MRI), Elisabeth Remy (Moi)

SynObs Info.

Contact E-Mail : synobs@mri-jma.go.jp

Webpage: https://oceanpredict.org/un-decade-of-ocean-science/synobs-2/

Mailing List: Request to the contact e-mail for joining

☆ Outline of SynObs Activity

1. Collaboration for evaluation and design

- Collaboration on a Multi-System OSE and OSSE (SynObs flagship OSEs)
- Establish the best practice through this collaboration.

2. Supporting DA scheme development for better use of observation data

- Share the information on the development of DA schemes through workshops and webs

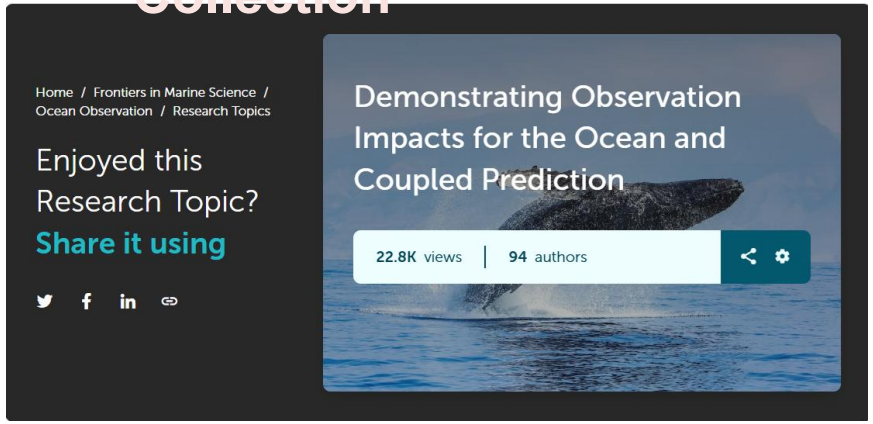
3. Framework to provide information from ocean prediction systems in real time

- Explore additional methods to evaluate observing system status in real-time

4. OS-Eval showcase and reporting

- to demonstrate the potential of observing system evaluation
- Contribute to observation impact reports by WMO and GOOS.

Frontiers in Marine Science Special Collection



https://www.frontiersin.org/research-topics/58025

★ Activities since last May

May 2025: JpGU2025: **organize a session, several presentations**

Jul. 2025: Busan IAMAS-IACS-IAPSO Joint Assembly 2025 (BACO2025): **presentation**

Sep. 2025: Pan CLIVAR Meeting and CLIVAR-GSOP Meeting: **presentation, discussion**

Nov. 2025: **Project Period of SynObs is officially extended to Dec. 2030.**

Nov. 2025: OceanPrediction DCC South East Asia Reginal Team Meeting, **presentation**

Dec. 2025: AGU2025, **presentation**

Jan. 2026: DITTO Online Event, **presentation**

Feb. 2026: Ocean Observing Co-design & SynObs Joint Session in OSM26 in Glasgow, **organize a session, several presentations**

Presentation by Billy Kessler in JPGU2025 SynObs Session

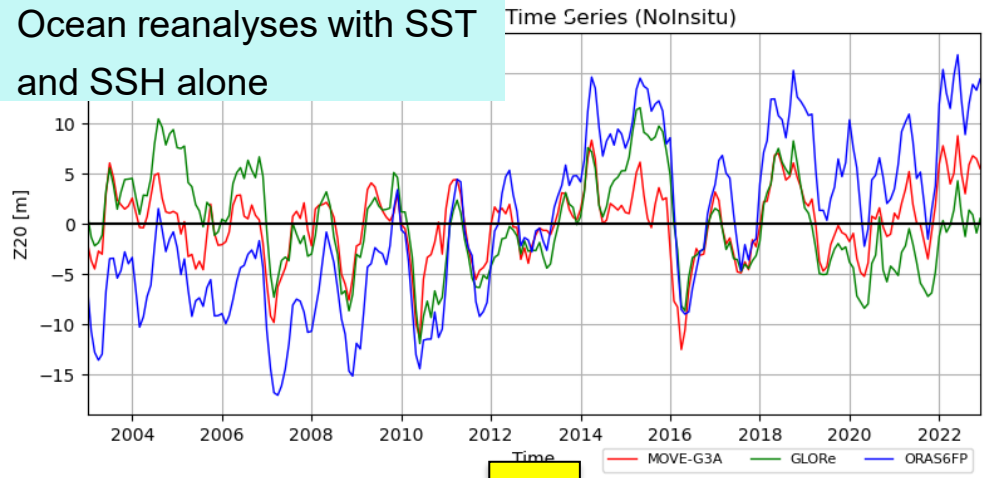
SynObs flagship OSEs

- Internationally coordinated **OSEs using multiple ocean reanalysis and prediction systems** with a common setting
  - **Observing System Experiment (OSE):** Reanalysis/prediction experiment to examine the sensitivity to observation data
- **To make robust evaluation** which does not depend on a particular system
- Results are stored as netCDF files in **the Japanese DTO on the JAMSTEC sever** and volunteer groups analyze observation impacts.

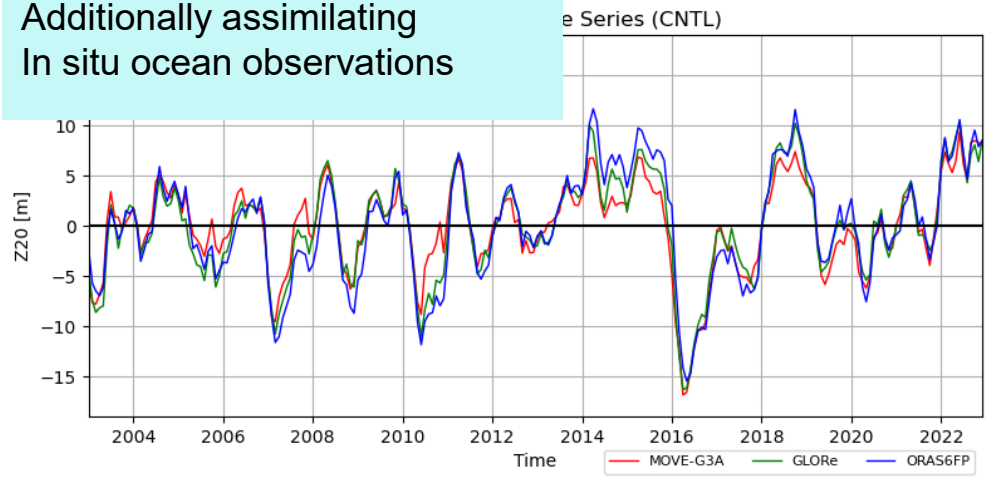
- Observation impact can be demonstrated by reduction of **multi-system Ensemble Spread (MSES)**, which represents **uncertainty** of analyses.
- For example, assimilating ocean in-situ observations effectively reduces MSES, i.e., the uncertainty of **Eq-Pac Warm Water Volume (WWV)** analysis (right figure).
  - **Eq-Pac WWV:** Depth of 20˚C isotherm (Z20) averaged over 5˚S-5˚N, 120˚E-80˚W.

Timeseries of Eq-Pac WWV

Ocean reanalyses with SST and SSH alone



Additionally assimilating In situ ocean observations



Systems: MOVE-G3A (JMA), GLORe (NOAA-CPC), ORAS6FP (ECMWF)

☆ SynObs Database (https://www.jamstec.go.jp/jcope/distributions/SynObsDB/)

- **The flagship OSE results** are collected in the SynObs database **in the Japanese DTO** on the JAMSTEC sever.
- **The data is freely open** for volunteer groups who analyzes the observation impacts using flagship OSE results.
- The data are stored in **the netCDF format**. You can easily **download the data by wget command**. JAMSTEC have been developing user interface currently.

	Daily	Pentad/Weekly	Monthly	Point Location
OP-OSE Analysis (OP-AN)	**OPA-D (OPA-DH)** Variables: OP-2 Resolution: 0.25°, 0.1° Frequency: Daily	**OPA-P** Variables: OP-1 Resolution: 0.25° Frequency: Pentad		**OPA-PL** Argo (Daily) Mooring (Hourly)
OP-OSE Forecast (OP-FC)	**OPF-D (OPF-DH)** Variables: OP-2 Resolution: 0.25°, 0.1° Lead Times: D1, D3, D7	**OPF-P** Variables: OP-1 Resolutions: 0.25° Lead Times: P1, P2		**OPF-PL** Argo (Daily, D1-D10) Mooring (Hourly, H1-H240)
S2S-OSE Analysis (S2S-AN)	**S2SA-D** Variables: S2S-2 Oc Resolution: 1° Frequency: Daily		**S2SA-M** Variables: S2S-1 Oc+Flx Resolution: 1° Frequency: Monthly	**S2SA-PL** Argo (Daily) Mooring (Daily)
S2S-OSE Forecast (S2S-FC)	**S2SF-D** Variables: S2S-3 Oc+Atm Resolution: 1° Lead Times: D1-D35	**S2SF-W** Variables: S2S-2 Oc+Atm Resolution: 1° Lead Times: W1-W18	**S2SF-M** Variables: S2S-1 Oc+Atm Res: 1° Lead Times: M1-M4	**S2SF-PL** Argo (Daily, D1-D126) Mooring (Daily, D1-D126)

Index of /distributions/SynObsDB

Name	Last modified	Size	Description
Extra/	2025-12-22 19:17	-	
OP-AN/	2025-09-18 19:16	-	
S2S-AN/	2025-09-25 16:29	-	

Name	Last modified	Size	Description
OPA-D_SST_20200101_M..>	2025-04-26 16:10	4.0M	
OPA-D_SST_20200102_M..>	2025-04-26 16:10	4.0M	
OPA-D_SST_20200103_M..>	2025-04-26 16:10	4.0M	
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OPA-D_SST_20200105_M..>	2025-04-26 16:10	4.0M	
OPA-D_SST_20200106_M..>	2025-04-26 16:10	4.0M	
OPA-D_SST_20200107_M..>	2025-04-26 16:10	4.0M	
OPA-D_SST_20200108_M..>	2025-04-26 16:10	4.0M	
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OPA-D_SST_20200111_M..>	2025-04-26 16:10	4.0M	
OPA-D_SST_20200112_M..>	2025-04-26 16:10	4.0M	
OPA-D_SST_20200113_M..>	2025-04-26 16:10	4.0M	
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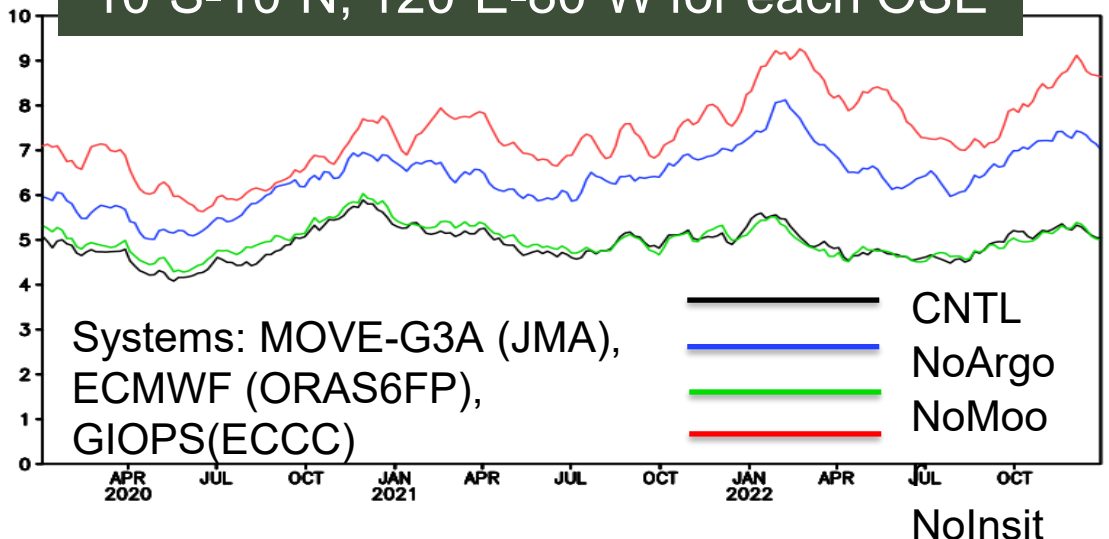
OPA-D_SST_20200115_M..>	2025-04-26 16:10	4.0M	
OPA-D_SST_20200116_M..>	2025-04-26 16:10	4.0M	

Z20 MSES Reduction by In-situ Observations

- Moorings and ships have substantial impact if Argo is absent (NoInsitu - NoArgo).
- Impact of moorings complementary to others is notable in the east. Eq. Pac. (NoMoor – CNTL)
- Argo data have large impact complementary to others in broad area (NoArgo – CNTL)

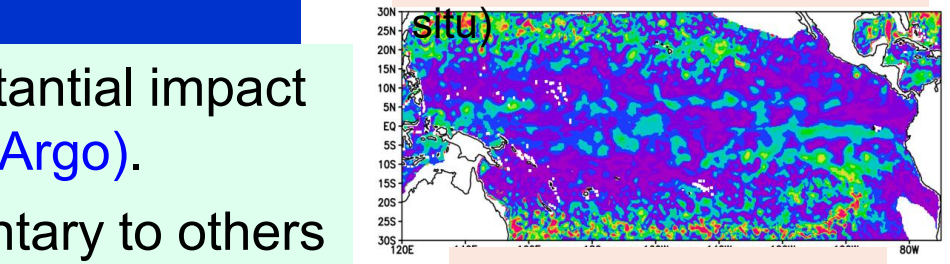
Impacts on predictions will also be investigated!

Time Series of Z20 MSES averaged in 10˚S-10˚N, 120˚E-80˚W for each OSE

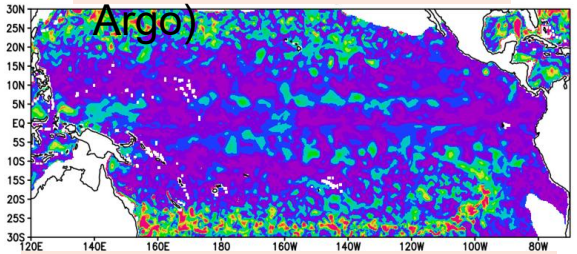


MSES of Z20 (2020-

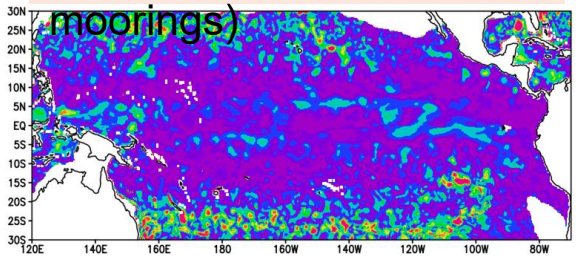
NoInsitu (without all In situ)



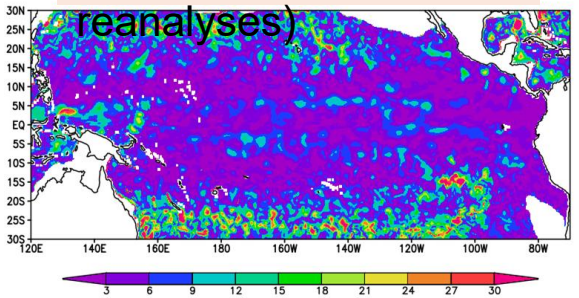
NoArgo (without Argo)



NoMoor (without moorings)

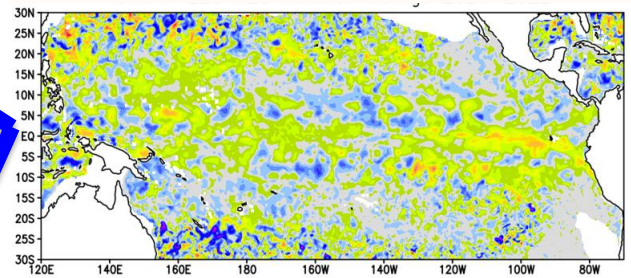


CNTL (regular reanalyses)

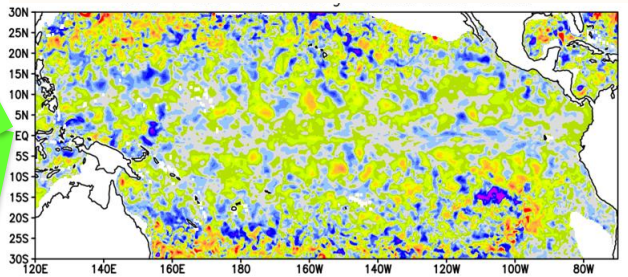


Difference of MSES

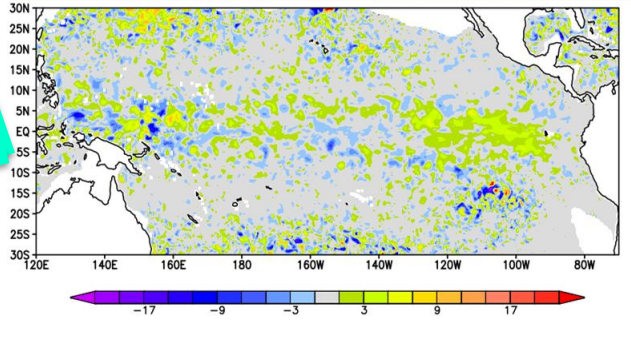
NoInsitu – NoArgo (Impact of moorings and ships if Argo is absent.)



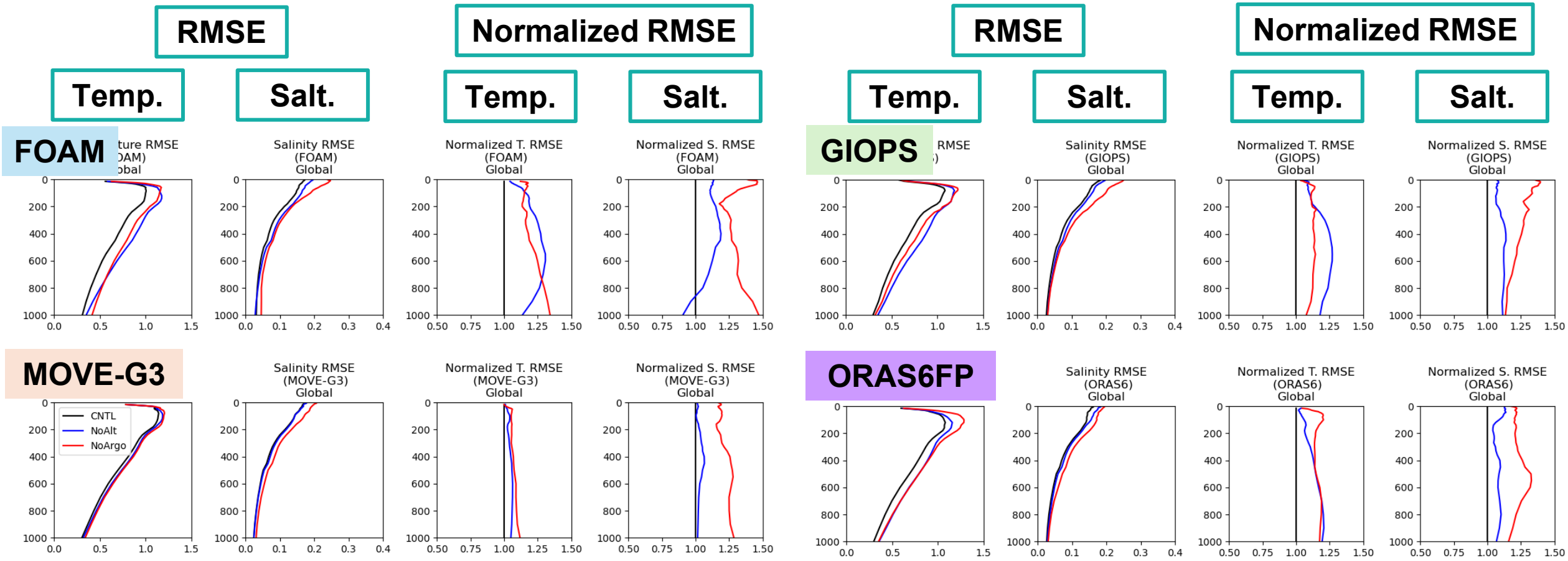
NoArgo – CNTL (Impact of Argo complementary to others)



NoMoor – CNTL (Impact of moorings complementary to others)



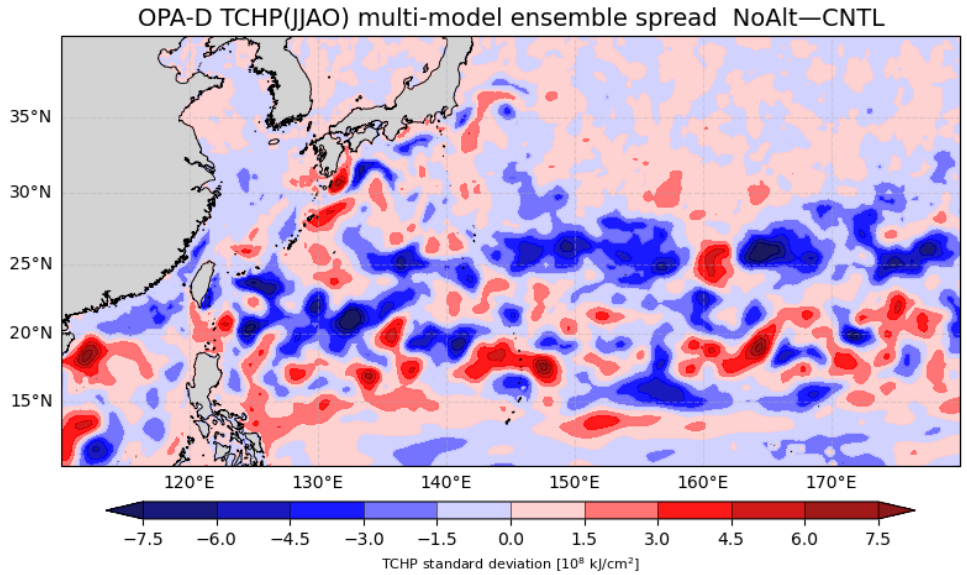
☆ RMSE profiles against independent Argo in 2020-2022 in each system

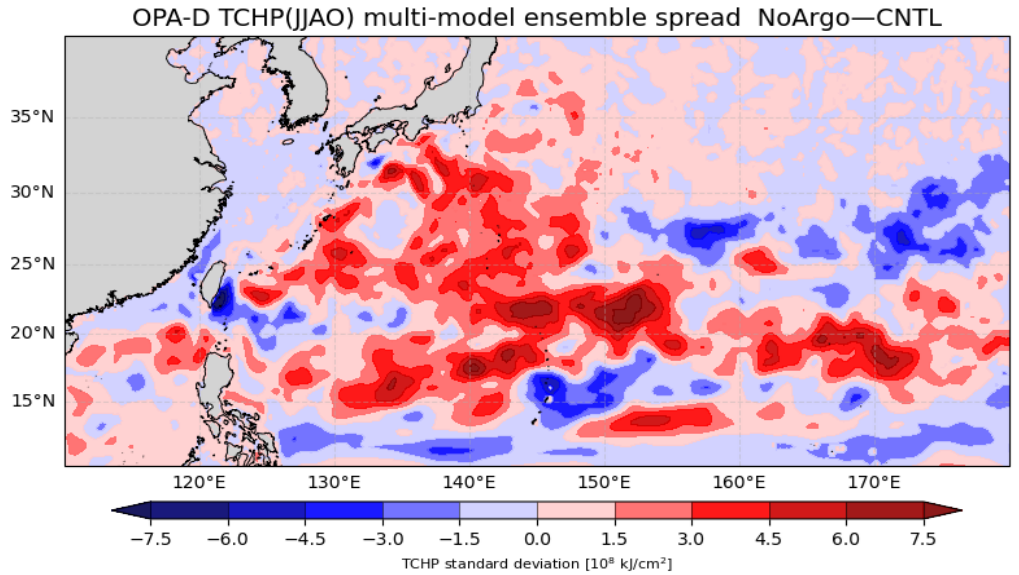


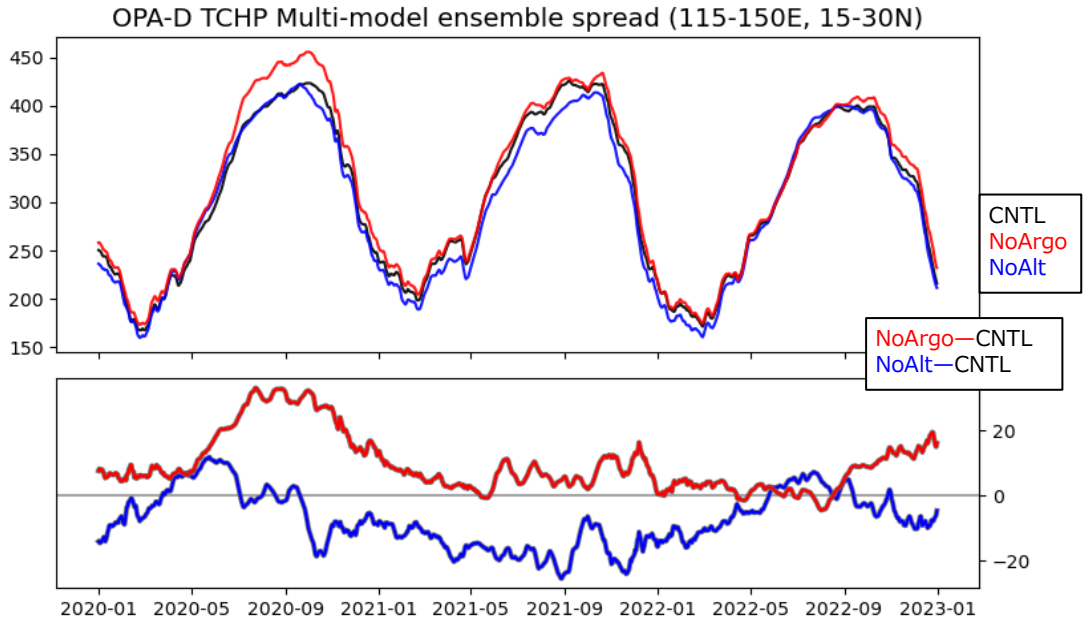
- ✓ Argo data mostly reduce the accuracy of temperature and salinity profiles in all systems.
- ✓ Impacts of satellite altimeters has dependency on systems. In FOAM, GIOPS, and ORAS6, the impact on temperature is substantial and that on salinity is moderate. In MOVE-G3, although the impact on temperature and salinity is positive but smaller than other systems. Although assimilating altimetry data are effective in the mid-latitudes, it is not easy to improve the interior ocean TS fields in the tropics.

☆ Impact of Altimeters and Argo on TCHP Uncertainty

(2020-2022, JJAO)



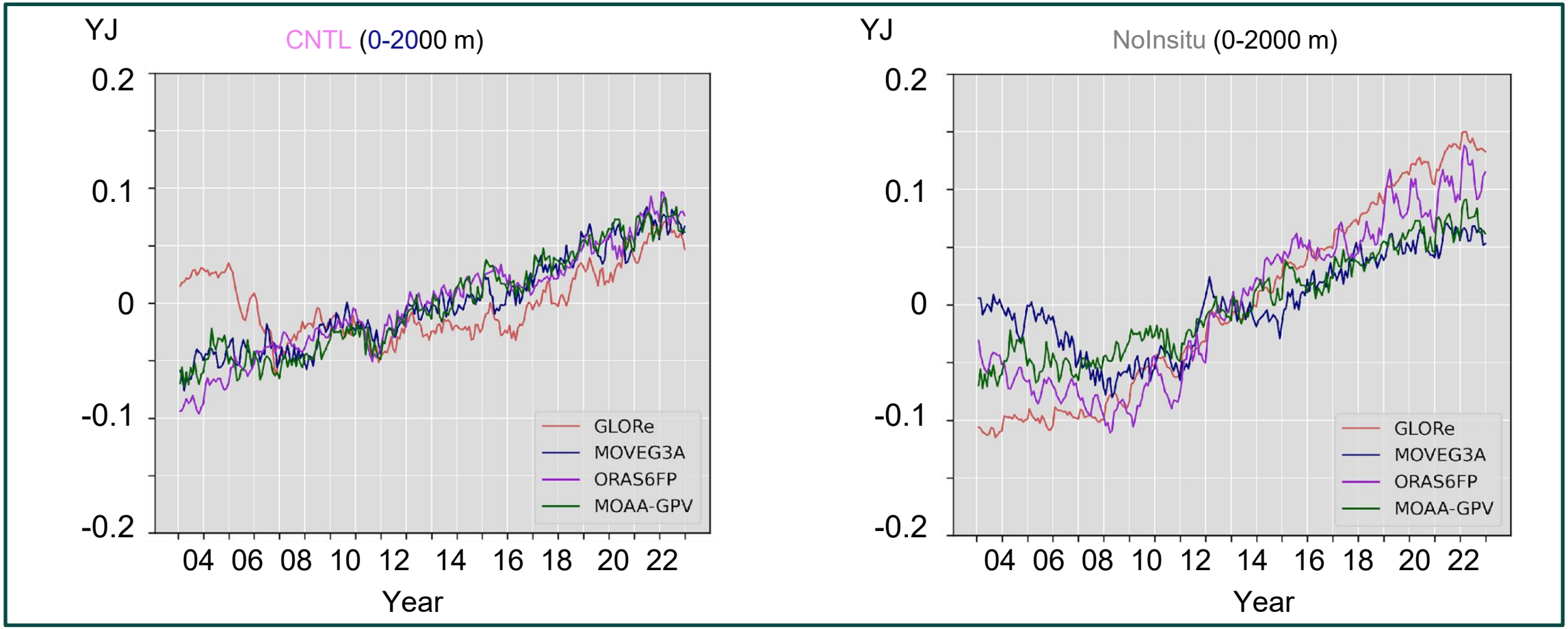




- Without Altimeter data, changes in uncertainty (ensemble spread) are roughly reduced due to the diversity of SLA assimilation methods.
- Without Argo data, uncertainty significantly increases across the broad region south of Japan, highlighting Argo's crucial role.
- Removing Argo data consistently increases analysis uncertainty throughout the year, whereas the impact of Altimeter data is generally negative.

☆ Impact on the Uncertainty of Global OHC anomaly

- In the CNTL experiment, OHC agrees well with observations in most systems, except for GLORe before 2007.
- In contrast, larger discrepancies appear among the systems in the NoInsitu experiment.



★ Collaboration with Observation Groups

- **GOOS** and **Ocean Observing Co-design** (UN Ocean Decade Program)
- **CLIVAR** (through **GSOP**)
- **WMO** Observation Impact Workshop and RRR
- **Argo Science Team** (Supporting the Position Paper by V. Thierry, and review on the Argo Impacts by Peter Oke)
- Tropical Pacific Observing System (**TPOS**) (Supporting the paper on the necessity of buoy array in the western equatorial Pacific by Sophie Cravatte)

Toward Codesigning Sustainable and Fit-for-purpose Ocean Observing

SynObs & Ocean Observing Codesign International Workshop 2026

- Period: 24 (Mon) – 29 (Sat), Aug., 2026.
- Location: Mutsu, Japan (Shimokita Culture Hall)
- Jointly organized with 30th Data Assimilation Summer School in Japan (10 international students will be accepted).
- Webpage: https://oceanpredict.org/events/synobs-ocean-observing-co-design-joint-international-workshop

Time Table

Time	24th Mon	25th Tue		26th Wed	27th Thu		28th Fri		29th Sat		30th Sun
9:20-10:20	Open. Sess.	SynObs MT	TC Exem. MT	Oral (Th.3)	Clos. Sess.	Sum. School	WS SOC MT	Sum. School		Sum. School	Sum. School
10:20-10:40	Coffee	Coffee		Coffee							
10:40-12:20	Oral (Th 1)	SynObs MT	TC Exem. MT	Flash talk + Oral (Th.2)	Excursion						
12:20-13:40	Lunch	Lunch		Lunch			Lunch		Town Hall	Lunch	
13:40-15:25	Oral (Th. 1/3)	Oral (Th.3)		Poster Sess.			Co-des. MT?	Sum. School and WS Joint Sess.		Sum. School	
15:25-16:00	Coffee	Coffee		Coffee							
16:00-16:45	Oral (Th. 2/1) + frash talk	Oral (Th. 3)		Oral (Th. 2)							
16:45-18:00		SynObs MT	Co-design MT	Discussion							
18:00-19:00					Barbeque						
19:00-22:00	Reception										

★ Status of Anstract Submission and Registration

- 62 abstracts are submitted (Closed on April 6th)
  - Oral: 41, Poster: 9, No Preference: 12
  - Participants: In-person: 39, Remote: 9, Unsure 10

- Themes (SOC will select 3 keynotes and 37 or 38 oral presentations)
  1. Development for better use of observations and methods of evaluations
     1 keynote+12 oral presentations
  2. Evaluation of observation impacts in ocean predictions and other applications
     1 keynote+12 oral presentations
  3. Sharing experiences of ocean observing-codesign
     1 keynote+12 oral presentations
  4. Discussion for future activities and OceanObs'29
     1 or 2 oral presentations and discussion

- Registration is now Open! (Will be closed May 23rd)

OSEval TT – 2025 activities

Activities since last year:

- 1 remote meeting: discussion on strategy for OSEval following internal OPEC discussion
- Observation table updated in january 2026:

  Observations table(s) (operational centre usage) - Ocean Predict

  Ocean observing networks are interested by this table to know and highlight the use of their data for real time analysis, forecasts.

➢ **Need to revive the TT** ! Next remote meeting to be planned in May

Doc to share ideas for presentations/topics open here: Proposed topics for OSEval webmeeting - Google Sheets, plan to invite Ocean Observation networks

Future activities (complementary to SynObs):

- Participate to Peter Oke paper on Argo: « The impacts of Argo data on ocean forecasting, seasonal prediction, reanalysis, and coupled prediction: a community perspective”
- Revisit the categories of « observation » in the dedicated table -> with OPOS WG
- Discusss methods for routine monitoring of observation impact (EFSO/FSOI, …) •with DA TT

Challenges

Real time monitoring on use, rejection and *impact of observations*: collaboration with DA, IV, OPOS TT

Report on observation impact assessment and RT monitoring:

Frontiers special issue -> updated list of publications on OP website, *regular OP short reports*

Build "Arguments" to advocate for OOS sustainability and fit-for-purpose evolution:

Need to find « user/application » oriented diagnostics to highlight societal benefit -> IV TT

Extend OSEval actvities to BGC/ecosystem modeling -> MEAP TT, **to coastal systems**: COSS-TT, **emerging observations** (SMART Cable, FVON, low cost sensors, citizen science…)

Designing / testing impact of future observation systems*: today mostly done with OSSE*

Use of alternative method ? Exist(ed) in R&D : array mode, Ens.SRF, AI…

Collaboration with relevant groups: OO networks (*Success story: Argo)*, « coupled » community (WMO working group, …), WMO-IOC/GOOS, …

Backups

★ Challenges on the SynObs Flagship OSEs

- All centers voluntarily conduct OSE runs using large computer resources. Therefore, we have not collected OSE results as we expected before.
- The analyses are also performed on the volunteer bases. Therefore, it is not easy to construct systematic international collaboration for the analysis. Currently, analyses are occasionally performed by some supporters.
- Diversity of Systems is larger than expected before especially in the case in-situ observations are not assimilated.
- Need to improve the infrastructure for the collaboration. (Functions of the database is insufficient.
- Sharing the evaluation/designing results with stake-holders of observing systems

★ Collection of the data for the flagship OSEs

➢ Data Collection for OP Analysis

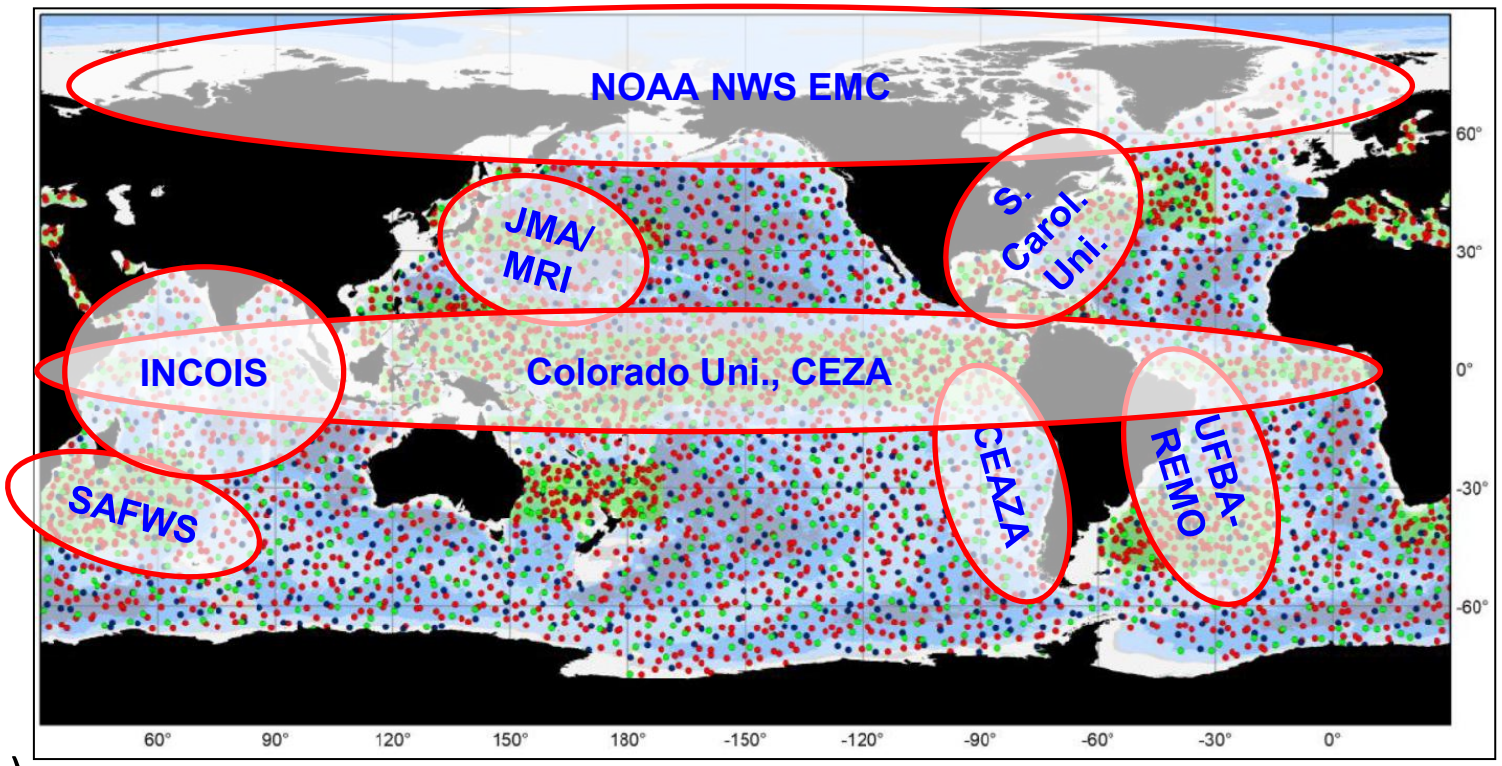
System	Center	OSEs	Period	Provided Data
FOAM	UKMO	CTL, NoAlt, NoArgo, Free, (HalfArgo)	2020-2022 (HalfArgo: only 2020)	Almost all
GIOPS	ECCC	CNTL, NoAlt, NoArgo, NoMoor, NoInsitu, NoSST, SSTonly, Free, HalfArgo, Oper	2020-2022	Almost All
JCOPE-FGO	JAMSTEC	CNTL, NoAlt, NoArgo	Only 2020	SSH, ArRef
MOVE-G3F	JMA/MRI	CTL, NoAlt, NoArgo, NoInsitu, NoMoor, NoSST, SSTonly, HalfArgo, Free, NoUSArgo	2020-2022	Almost All
MOVE-NPR	JMA/MRI	CTL, NoAlt, NoArgo	2020	SSH, 50mT
ORA6FP	ECMWF	CTL, NoALt, NoArgo, NoInsitu, NoMoor, NoSST, Free	2020-2022	Almost All
OPEM_MOM5	Pukyon U.	CTL, NoAlt, NoArgo, HalfArgo, Free	2020	Only daily data

➢ Data Collection for S2S Analysis (2003-2022)

System	Center	OSEs	Period	Provided Data
MOVE-G3A	JMA/MRI	CTL, NoAlt, NoArgo, NoMoor, NoSST, HalfAlgo, Noinsitu, Free, SSTonly, NoUSArgo	2003-2022	Almost All
ORA6FP	ECMWF	CNTL, NoAlt, NoArgo, NoInsitu, NoSST	2003-2022	Only monthly data
GLORe	NOAA-CPC	CNTL, NoInsitu, Free	2003-2022	Only monthly data

★ How will we analyze OSE/OSSE results? (Discussion before)

- **Assign variables/diagnostics and regions to potential groups and request analysis.**
- Analysis of variables or diagnostics for the global ocean
  - Impact of Argo on heat budget and surface flux (ECCC)
  - Diagnostics related to tropical cyclone　(Ocean Observing CoDesign TC Exemplar Team)
  - Comparison b/w forecasted value and Argo observation (OceanPredict IV-TT)
  - Trajectory of Drifters (UKMO)
  - Heat budgets and MHWs（ECMWF）
  - Near-surface ocean current（ABoM）
- **Regional Analysis**
  - MLD in tropics (Colorado Uni)
  - Tropical waves ・Peru coast (CEZA)
  - WN Pacific (JMA/MRI)
  - Brazilian Coast (UFBA-REMO)
  - Agulhas Current (SAFWS)
  - Arctic and Antarctic (NOAA NWS EMC)
  - Indian Ocean (INCOIS)
  - Western North Atlantic (S. Caroline Uni.)



3. Results : Global OHC anomaly

- In the NoInsitu experiment, OHC in both shallow and deep layers differs substantially among the three systems.
  → This highlights the importance of in situ observational data.

- MOVE-G3A reproduces the OHC trend most consistent with observation-based mapping, MOAA-GPV, among the systems.